Contents

Preface	vii
I. The Gulf's Setting	
Physical Environment of the Gulf Relevant to Marine Pollution: An Overview by Charles R. C. Sheppard	3
The Gulf: Its Biological Setting by A. R. G. Price, C. R. C. Sheppard and C. M. Roberts	9
The Gulf: Human Impacts and Management Initiatives by A. R. G. Price	17
II. Post-War Biophysical Assessment	
Physical and Chemical Environment	
Mt Mitchell Oceanographic Expedition in the Gulf by Robert C. Clark, Jr and Lisa C. Symons	31
Physical Oceanography of the Gulf, Strait of Hormuz, and the Gulf of Oman: Results from the Mt Mitchell Expedition by R. Michael Reynolds	35
Computation of the Residual Flow in the Gulf using the Mt Mitchell Data and the KFUPM/RI Hydrodynamical Models	
by R. W. Lardner, A. H. Al-Rabeh, N. Gunay, M. Hossain, R. M. Reynolds and W. J. Lehr	61
On Mathematical and Empirical Models for Surface Oil Spill Transport in the Gulf by Ala Al-Rabeh, Robin Lardner, Nazmi Gunay, Rizwanullah Khan, Mahmood Hossain, R. M. Reynolds and W. J. Lehr	71
The Influence of the Kuwaiti Oil Well Fires on Seawater Temperature in the Western Gulf by John C. McCain, Daniel W. Beard and Yusef H. Fadlallah	79
State of Oil Pollution in the Northern Arabian Sea after the 1991 Gulf Oil Spill by R. Sen Gupta, S. P. Fondekar and R. Alagarsamy	85
Distribution of Oil along the Saudi Arabian Coastline (May/June 1991) as a Result of the Gulf War Oil Spills by Erich R. Gundlach, John C. McCain and Yusef H. Fadlallah	93
Chemical Characterization of Sediments from the Gulf Area after the 1991 Oil Spill by Abdulrahman A. Al-Arfaj and Ibrahim A. Alam	97
Trace Elements in Sediments of the Western Gulf by Ali S. Basaham and Sultan S. Al-Lihaibi	103
Contamination of Nearshore Subtidal Sediments of Saudi Arabia from the Gulf War Oil Spill by Jacqueline Michel, Miles O. Hayes, Richard S. Keenan, Theodor C. Sauer, John R. Jensen and	100
Sunil Narumalani	109
Hydrocarbon Source Identification and Weathering Characterizaton of Intertidal and Subtidal Sediments Along the Saudi Arabian Coast after the Gulf War Oil Spill by Theodor C. Sauer, John S. Brown, Paul D. Boehm, Don V. Aurand, Jacqueline Michel and	
Miles O. Hayes	117
Distribution and Weathering of Shoreline Oil One Year After the Gulf War Oil Spill Miles O. Hayes, Jacqueline Michel, Todd M. Montello, Don V. Aurand, Ahmed M. Al-Mansi, Abdul Halim Al-Moamen, Theodor C. Sauer and Gordon W. Thayer	135
Marine and Coastal Ecosystems	
Broadscale Changes in Coastal Ecosystems of the Western Gulf following the 1991 Gulf War by A. R. G. Price, T. J. Wrathall, P. A. H. Medley and A. H. Al-Moamen	143
Has the Gulf War Affected Coral Reefs of the Northwestern Gulf? by Nigel Downing and Callum Roberts	149

Short-term Damage to Coastal Bird Populations in Saudi Arabia and Kuwait Following the 1991 Gulf War Marine Pollution by M. I. Evans, P. Symens and C. W. T. Pilcher	157
Effect of the 1991 Gulf War on Metal Bioaccumulation by the Clam (Meretrix meretrix) by M. Sadiq and J. C. McCain	163
Petroleum Hydrocarbons and Trace Metals in Nearshore Gulf Sediments and Biota Before and After the 1991 War: An Assessment of Temporal and Spatial Trends	
by S. W. Fowler, J. W. Readman, B. Oregioni, JP. Villeneuve and K. McKay	171
Concentration of Heavy Metals in Marine Organisms Around Qatar Before and After the Gulf War Oil Spill by Tariq W. Kureishy	183
Hydrocarbons and Related Photo-oxidation Products in Saudi Arabian Gulf Coastal Waters and Hydrocarbons in Underlying Sediments and Bioindicator Bivalves by Manfred G. Ehrhardt and Kathryn A. Burns	187
Subtidal Benthic Community Respiration and Production near the Heavily Oiled Gulf Coast of Saudi Arabia	100
by Kathryn A. Burns, Manfred G. Ehrhardt, Brian L. Howes and Craig D. Taylor	199
Anomalous Pneumatophores and Adventitious Roots of Avicennia marina (Forssk.) Vierh. Mangroves Two Years After the 1991 Gulf War Oil Spill in Saudi Arabia by Benno Böer	207
Ecology of Seagrasses in Northeastern Saudi Arabia One Year After the Gulf War Oil Spill by W. J. Kenworthy, M. J. Durako, S. M. R. Fatemy, H. Valavi and G. W. Thayer	213
Assessment of the Toxicity of Kuwait Crude Oil on the Photosynthesis and Respiration of Seagrasses of the Northern Gulf by Michael J. Durako, William J. Kenworthy, Seyed M. R. Fatemy, Hamseh Valavi and	
Gordon W. Thayer	223
Preliminary Damage Assessment of Algal Mats Sites Located in the Western Gulf Following the 1991 Oil Spill by Assad A. Al-Thukair and Khattab Al-Hinai	229
Post-Spill Zooplankton Distribution in the NW Gulf by F. Y. Al-Yamani, K. Al-Rifaie and W. Ismail	239
Planktonic Decapoda from the Western Coast of the Gulf by Ali M. Al-Aidaroos	245
Fisheries and Fish	
Preliminary Assessment of the Effects of the 1991 Gulf War on Saudi Arabian Prawn Stocks by C. P. Mathews, S. Kedidi, N. I. Fita, A. Al-Yahya and K. Al-Rasheed	251
Abundance of Zooplankton and Penaeid Shrimp Larvae in the Western Gulf: Analysis of Pre-War (1991) and Post-War Data	
by A. R. G. Price, C. P. Mathews, R. W. Ingle and K. Al-Rasheed	273
Fisheries Study in the Gulf by O. A. Hashim	279
Analyses for Petroleum-related Contaminants in Marine Fish and Sediments Following the	
Gulf Oil Spill by Margaret M. Krahn, Gina M. Ylitalo, Jon Buzitis, Jennie L. Bolton, Catherine A. Wigren, Sin-Lam Chan and Usha Varanasi	285
Cytochyrome P450 Observations in Gulf Fish by Jonny Beyer and Anders Goksøyr	293
	2)5
Polycyclic Aromatic Hydrocarbons in Edible Tissue of Fish from the Gulf After the 1991 Oil Spill by Sami Al-Yakoob, Talat Saeed and Huda Al-Hashash	297
III. Pollution Control and Conservation	
On the Impacts of the 1991 Gulf War on the Environment of the Region: General Observations by Makram A. Gerges	305
The Creation of a Marine Sanctuary after the 1991 Gulf War Oil Spill	
by Friedhelm Krupp and David A. Jones	315

Intertidal Clean-up Activities and Natural Regeneration on the Gulf Coast of Saudi Arabia from 1991 to 1992 after the 1991 Gulf Oil Spill by Iain Watt, Timothy Woodhouse and David A. Jones	325
Saudi Arabia's Response to the 1991 Gulf Oil Spill by Nizar I. Tawfiq and David A. Olsen	333
IV. Synthesis and Conclusions	
Considerations for the Assessment of Environmental Consequences of the 1991 Gulf War by Peter Literathy	349
The 1991 Gulf War Oil Spill—Lessons from the Past and a Warning for the Future by Ibrahim A. H. Alam	357
Multi-disciplinary Modelling: an Overview and Practical Implications for the Governance of the Gulf Region by J. M. McGlade and A. R. G. Price	361
Index—Volume 27.	377

·

